

PROCEEDINGS
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NOTES ON SOME FISHES FROM THE CANAL ZONE.*

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Mr. August Busck of the Division of Entomology, U. S. National Museum, spent several weeks in the Canal Zone in the early part of 1907, studying the mosquitoes of that region.

These studies naturally led him to make some observations on the fishes, particularly the smaller freshwater species, with reference to their feeding habits. Specimens of a number of species were collected and preserved and later turned over to the Bureau of Fisheries for identification.

Later (in 1908), at the instance of Mr. Busck, a second considerable collection was received from Mr. Allan H. Jennings, Office Chief Sanitary Inspector, Ancon, Canal Zone.

The localities represented in the collections made by Mr. Busck are as follows:

1. *Rio Boqueron*. This stream is one of the headwaters of the Chagres River. It was examined at a point in Colombia near the coast and about 40 or 50 miles from the Canal Zone. At that place the Boqueron is a small stream not over 40 feet wide and never getting much wider, although subject to great and sudden floods. At one time it rose 9 feet in 2 hours.

Dynamite was used in collecting in this stream, in which small fishes were very abundant. Mr. Busck collected at this place in May, 1907.

2. *Taboga Island*. This island is on the Pacific side about 10 to 15 miles due east from Panama.

The specimens from this place were obtained from tidepools July 4, and all belong to saltwater species.

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3. *Tabernilla*. This is a small town in Atlantic drainage, about midway between the Atlantic and Pacific coasts. The specimens obtained here are all from a small stream not more than 2 feet wide rising in a small spring which was full of leaves and small fishes. When a quantity of water was dipped up from the spring there was quite as much leaves and fishes as water. Mosquito larvæ were abundant and seemed to be living amicably with the fishes; the fish did not seem to be eating the larvæ or the mosquitoes. Collections were made by Mr. Busck at this place.

The collections by Mr. Jennings were made at Tabernilla in January and July, at Gorgona and Paraiso in February, and at Caldera Island, Porto Bello Bay, in January, March, and April, all in 1908.

The specimens of *Gambusia episcopi*, *Pecilia sphenops*, and *Agonostomus monticola* from Caldera Island were taken from a small mountain brook.

The construction of the Panama Canal is a matter of great importance to students of the geographic distribution of animals and plants. The completion of the canal will establish a permanent waterway and means of communication between the Atlantic and Pacific coasts of America, which in time is sure to affect very materially the geographic distribution of many of the species of aquatic animals and plants in that region. It is highly probable that in time many, if not all, of the brackish water species of fishes and crustaceans and other invertebrates of that region will find their way through the canal from one side to the other; and it is not at all improbable that some purely saltwater species will pass from one side to the other.

But of still greater importance are the changes in the animal and plant life which will result from the construction of the Gatun Dam and the formation of Gatun Lake. This lake or reservoir will cover many square miles of territory now entirely out of water, and consisting of hills and valleys, and canyons and small plains, through and among which run a number of large rivers, such as the Rio Chagres, Rio Trinidad, Rio Gatun, and a great number of smaller streams. Practically all of these streams will be wiped out of existence when the land through which they now flow becomes converted into the proposed large lake. Some of the aquatic species inhabiting them will be wiped

out of existence, and even those which are not exterminated will have their geographic distribution seriously affected and their habits more or less changed. It is a source of great regret to biologists that the Government has not appreciated the necessity for a thorough biological survey of the Canal Zone before the completion of the canal. It is not yet too late to make such a survey, but it must be made before the canal is completed; else problems which can now be solved will then remain forever unsolved.

The collection of fishes upon which this paper is based, although small, is nevertheless of considerable importance, and it is highly desirable that the facts gained from their study be put on record.

FAMILY CHARACINIDÆ.

THE CHARACINS

1. *Astyanax æneus* (Günther).

Seven specimens, 40 to 47 mm. long, from Tabernilla, January 15.

Ten specimens, 65 to 105 mm. long, from Rio Boqueron.

2. *Astyanax fischeri* Steindachner.

Twenty-five specimens, 35 to 63 mm. long, from Tabernilla, July 24.

Three specimens, 55 to 63 mm. long, from a small pool at Paraiso, February 1.

These two species are doubtfully distinct. *A. fischeri* seems to differ, however, from *A. æneus* in the slightly larger eye, slightly greater depth, and in the coloration, the former always having a vertical black humeral spot bordered on each side by silvery, and a black caudal spot which does not extend on the caudal rays.

A comparison of our specimens of *A. æneus* with 2 examples of *A. macrophthalmus* from the Rio Tonto, Mexico, kindly sent us by Mr. C. Tate Regan, shows them to be distinct, as evidenced by the slightly larger eye and higher dorsal fin of *A. macrophthalmus*. We are unable to observe any differences in the anal fin.

For purposes of comparison we give comparative measurements of a series of specimens of each of the species, *A. fischeri*, *A. æneus*, and *A. macrophthalmus*.

Astyanax fischeri.

Length in mm.	Head in length	Eye in head	Scales	Dorsal fin	Anal fin		Locality
				Longest ray in head	Formula	Longest ray in head	
63	3.8	2.8	8-33-6	1.1	24	1.6	Paraiso, Canal Zone
57	3.8	2.8	9-34-6	1	24	1.6	“ “
63	3.3	2.6		1.2	23	1.5	Tabernilla “
52	3.4	2.4		1.2	24	1.6	“ “
52	3.4	2.5		1	24	1.5	“ “
51	3.8	2.5		1.2	24	1.6	“ “
49	3.6	2.5		1.1	26	1.6	“ “
43	3.2	2.2		1.2	23	1.6	“ “
40	3.2	2.3		1.2	24	1.6	“ “
38	3.4	2.4		1.2	26	1.6	“ “
37	3.4	2.1		1.2	26	1.8	“ “
35	3.3	2.2		1.2	25		“ “

Astyanax weus.

47	3.5	2.8		1	25	1.6	Tabernilla, Canal Zone
46	3.5	2.6		1.1	24	1.5	“ “
45	3.3	2.7		1.2	23	1.5	“ “
45	3.5	2.6		1.1	26	1.8	“ “
44	3.6	2.6		1.2	24	1.6	“ “
40	3.6	2.5		1.1	24	1.7	“ “
90	3.8	3	9-33-6	1.1	24	1.6	Rio Tonto, Mexico
88	4	3.1	9-33-6	1.1	26	1.5	“ “
95	4	3	36	1.2	26	1.5	Taboga Island
86	3.5	3	40	1.2	26	1.6	“ “
76	3.75	2.65	36	1.2	26	1.65	“ “
70	3.75	3	33	1.1	25	1.6	“ “
65	3.75	2.65	35	1			“ “

Astyanax macrophthalmus.

94	4	2.5	33	1.2	25	1.5	Rio Tonto, Mexico
77	4	2.5	9-33-6	.8	25	1.8	“ “

3. *Cheirodon insignis* Steindachner.

Head 3.8 in length; depth 3; eye 2.6 in head; snout 4; interorbital 1 in eye; dorsal 10; anal 20; scales 6-34-4, 7 pores on right side and 10 on left.

Body short, greatly compressed, the dorsal and ventral outlines nearly evenly arched, the dorsal somewhat the more strongly; head short, snout blunt. Teeth in a single row in each jaw, each with about 5 equal cusps, and two smaller ones differing in this respect very markedly from *Astyanax* in which the cusps consist of a central large one with one or two small lateral ones on either side. Scales rather large, lateral line incomplete, the pores usually developed only on 6 to 12 scales. Fins well developed, the height of the dorsal somewhat greater than length of head, that of the

anal about 1.5 in head. Color in alcohol, silvery straw-color above, plumbeous on middle of side, lower parts pale; a large black spot on caudal peduncle at base of caudal fin, followed by a pale area, the black not extending to caudal rays.

The above description from a specimen 39 mm. long from a small running ditch at Tabernilla, where it was obtained July 24, 1908, by Mr. Allan H. Jennings. Seventeen others taken at the same time and place, measure from 30 mm. to 40 mm. and agree in all essential respects. The number of pores in the lateral line varies from 6 to 12, the most usual number being 10.

Cheirodon insignis Steindachner, Zur Fisch—Fauna des Cauca und der Flüsse bei Guayaquil, 22, fig. 3, pl. VI, 1880, Cauca River, United States of Colombia.

4. *Cheirodon gorgonæ* Evermann & Goldsborough, sp. nov.

Type, No. 64094 U. S. National Museum, a specimen 28 mm. long, collected February 7, 1908, by Mr. A. H. Jennings, from a small seepage pool below the spillway of the reservoir dam at Gorgona, Canal Zone.

Head 3.7 in length; depth 3.14; eye 2 in head; longest dorsal ray 1 in head; longest anal ray 1.57 in head; dorsal II, 10; anal II, 17; scales in longitudinal series 29+4, pores on 8 of them, 10 scales in cross series from front of anal upward and forward to origin of dorsal; 13 scales in front of dorsal.

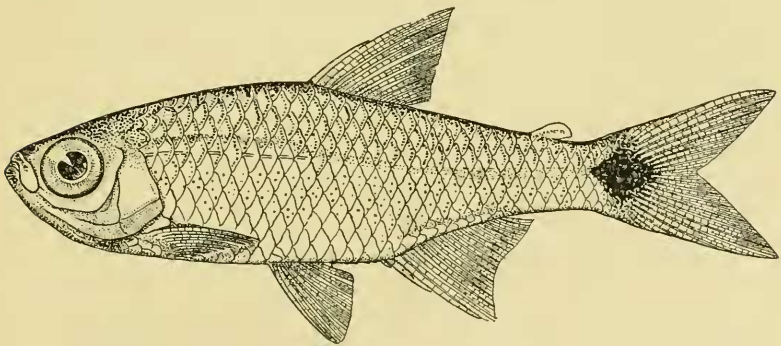


Figure 1.
Cheirodon gorgonæ Evermann & Goldsborough. Type.

Body short, compressed; dorsal and ventral outline evenly arched; head short; snout blunt; mouth small, oblique, maxillary reaching eye; teeth in a single row in each jaw, each evenly convex, with a large central cusp and 3 graduated smaller ones on either side, differing in this respect from *C. insignis*, which has the five central cusps of about equal size with one smaller one on either side, the outer edge being not nearly so arched as in the present species. Scales moderate, lateral line incomplete, it being developed on only 8 scales in the type, but varying in other specimens from 8 to 13; fins all well developed.

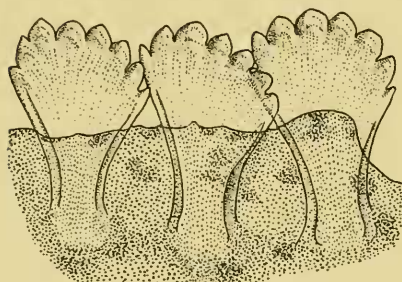


Figure 2.
Teeth of *Cheirodon insignis*.



Figure 3.
Teeth of *Cheirodon gorgonae*.

General color, reddish brown, this appearance due to the reddish brown punctulations at the posterior edge of the scales, these punctulations more numerous and giving the fish a somewhat darker appearance on the entire part of the body above the median line, and on the posterior part of entire body from origin of anal; centers of scales light, except those between ventral and pectoral fins and median line, where the scales have a silvery reflection; a very dark oval or nearly round spot, about the size of eye, on last scales at base of caudal and extending slightly beyond the scales on to the rays of the caudal; fins with some reddish brown body color, growing lighter toward tips where there are indications of dark punctulations; a narrow darkish lateral stripe, growing silvery anteriorly.

This species is very closely related to *C. insignis*, but differs in the very peculiar teeth, the larger eye, the fewer anal rays and the slightly shorter dorsal ray.

COMPARATIVE MEASUREMENTS OF 3 SPECIMENS OF *Cheirodon insignis*
AND 6 OF *Cheirodon gorgonae*.

Length in mm.	Head in length	Depth in length	Eye	Dorsal fin		Anal fin		Locality
				Form- ula	Long- est ray in head	Form- ula	Long- est ray in head	
<i>C. insignis</i>								
35	3.8	3	2.5	10	.8	22	1.5	Tabernilla, Canal Zone
39	3.8	3	2.6	10	.8	21	1.8	"
31	3.6	2.8	2.5	10	.8	21	1.4	"
<i>C. gorgonae</i>								
25	3.8	3.1	2.2	10	1.	19	1.4	Gorgona, Canal Zone
26	3.7		2.3	10	1.	18	broken	"
30	3.8	3.1	2.40	10	broken	18	"	"
*28	3.7	3.14	2.45	10	1.	17	1.57	"
27	3.6	3.2	2.3	10	1.	17	broken	"
26	3.5	3	2.25	10	1.	19	1.6	"

* The type.

We have also 11 cotypes, all collected by Mr. Jennings at the same time and place as the type. One of these has been sent to Mr. C. Tate Regan of the British Museum, one to Dr. C. H. Eigenmann of Indiana University, one to the Museum of Stanford University, and one to the Field Museum of Natural History. Of the remaining 8, 5 are in the U. S. National Museum, and 3 in the Reserve Series of the Bureau of Fisheries as No. 5421.

5. **Brycon striatulus** (Kner).

Seven specimens ranging in length from 2.5 to 4 inches, from Rio Boqueron.

Dorsal 10; anal 36; scales about 70.

6. **Rœboides guatemalensis** (Günther).

Ten specimens, $3\frac{5}{8}$ to 5 inches long, from Rio Boqueron and 9, 2.5 to 4 inches long, from a running ditch at Tabernilla.

Dorsal 10; anal 48; scales 78 to 80.

FAMILY SYMBRANCHIDÆ.

THE SYMBRANCHOID EELS.

7. **Symbranchus marmoratus** Bloch.

One specimen, 8 inches long, from Rio Boqueron.

FAMILY ANGUILLIDÆ.

THE EELS.

8. **Anguilla rostrata** (Le Sueur).

COMMON EEL.

Three examples, 2.5 to 3.75 inches long, from Caldera Island, Porto Bello Bay.

FAMILY PECILIIDÆ.

THE KILLIFISHES.

9. **Rivulus godmani** Regan.

One specimen, $1\frac{3}{4}$ inches long, collected by Mr. Busck in a small stream at Tabernilla.

Head 4 in length; depth 5.14; eye 2.75 in head; snout 4.5; dorsal 7; anal 12; pectoral 12; scales 36, 25 before dorsal.

This specimen differs from any description we can find of any *Rivulus* in having no ventral fins. Since one of the ventral fins is sometimes absent in members of this family and we have but the single specimen, we hesitate to separate it from *godmani* which it otherwise seems to be.

A very interesting structure in this specimen is the "cyclopean eye" in the center of the occiput. It consists of a large round scale-like formation, as large as eye, with radiating striae. We can find no reference to such a structure nor anything like it in specimens of many genera that we have examined.

10. **Gambusia episcopi** Steindachner.

Two female specimens, 2 and $2\frac{3}{4}$ inches long, from a small mountain brook on Caldera Island, Porto Bello Bay, January 24, 1908. These are

fine specimens showing very distinctly the dark spot on middle anal base. Each has many eggs with the young, fairly well developed, curved around the yolk and fully formed.

Twenty-nine specimens, $\frac{7}{8}$ to $1\frac{1}{2}$ inches long, from reservoir stream, Caldera Island, Porto Bello Bay, April 9, 1908. All of these but four have the prolonged anal fin. The smallest of these four is 1 inch long. In all the others the first 3 or 4 anal fin rays are produced and show a white color in alcohol, behind which is the dark falcate spot extending nearly to tip of fin.

Dorsal 8; anal 9; scales 27; teeth fixed, in a narrow band, no large ones.

11. *Pœcilia sphenops* Cuvier & Valenciennes.

Six specimens, $\frac{3}{4}$ to $1\frac{1}{4}$ inches long, from a small stream at Tabernilla, agreeing well with current descriptions.

Four specimens, $1\frac{3}{4}$ to $2\frac{1}{2}$ inches long, from Caldera Island, Porto Bello Bay. The smallest one of these is a male. The others are females, the largest of which had many well-developed young, one of them being $\frac{3}{8}$ of an inch long.

Three females, each about $1\frac{1}{2}$ inches long, from a small mountain stream on Caldera Island.

Thirty-five specimens, $\frac{5}{8}$ to $2\frac{1}{2}$ inches long, from Paraiso.

Twenty-five specimens, $\frac{7}{8}$ to 2 inches long, from a small seepage pool below spillway of reservoir dam at Gorgona. In these specimens and those from Paraiso there seems to be but a single row of teeth in each jaw, an outer row of movable conic teeth; if there are smaller teeth behind this row they are most minute and invisible with a good lens.

Fifty specimens, $\frac{3}{4}$ to $2\frac{1}{4}$ inches long, from Tabernilla, January 15, 1908.

Five specimens, $\frac{3}{4}$ to $1\frac{5}{8}$ inches long, from Tabernilla, and 12 specimens, 1 to 2 inches long, from Río Boqueron.

One example, a female 2 inches long, contained 60 young developed sufficiently to show the eyes plainly. This species is evidently viviparous.

Dorsal 9; anal 7; scales 28 to 30; teeth very small, conical, in a single row or very narrow band, movable.

FAMILY ARGENTINIDÆ.

THE SILVERSIDES.

12. *Thyrina pachylepis* (Gill).

One specimen, 2 inches long, from Río Boqueron.

Panama is the type locality of this species.

FAMILY MUGILIDÆ.

THE MULLET.

13. *Agonostomus monticola* (Baneroff).

Two specimens, $3\frac{1}{4}$ and $3\frac{1}{2}$ inches long, from a small mountain brook on Caldera Island.

Dorsal IV, 8; anal 9; scales 38.

FAMILY POLYNEMIDÆ.

THE THREADFISHES.

14. **Polydactylus approximans** (Lay & Bennett).

Four specimens, $\frac{3}{8}$ to $1\frac{3}{8}$ inches long, from Taboga Island.

FAMILY CICHLIDÆ.

THE CICHLIDS.

15. **Æquidens cæruleopunctatus** (Kner & Steindachner).

Fourteen specimens, $1\frac{1}{2}$ to $4\frac{1}{4}$ inches long, from Tabernilla.

Nine specimens, $1\frac{1}{8}$ to 2 inches long, from Rio Boqueron.

Dorsal XV, 10; anal III, 7; scales 25.

FAMILY TEUTHIDIDÆ.

THE TANGS.

16. **Teuthis crestonis** Jordan & Starks.

Three young examples from Taboga Island.

FAMILY BALISTIDÆ.

THE TRIGGERFISHES.

17. **Balistes naufragium** Jordan & Starks.

One young example from Taboga Island.

FAMILY TETRAODONTIDÆ.

THE PUFFERS.

18. **Spheroides annulatus** (Jenyns).

Five young examples from Taboga Island.

FAMILY GOBIIDÆ.

THE GOBIES.

19. **Mapo fuscus** (Rüppell).

Five specimens, $2\frac{3}{8}$ to 4 inches long, from Taboga Island.

20. **Eleotris pisonis** Gmelin.

Nine specimens, $1\frac{1}{4}$ to $3\frac{1}{2}$ inches long, from Caldera Island.